Laser Welds for AMS 02 TTCS Evaporator

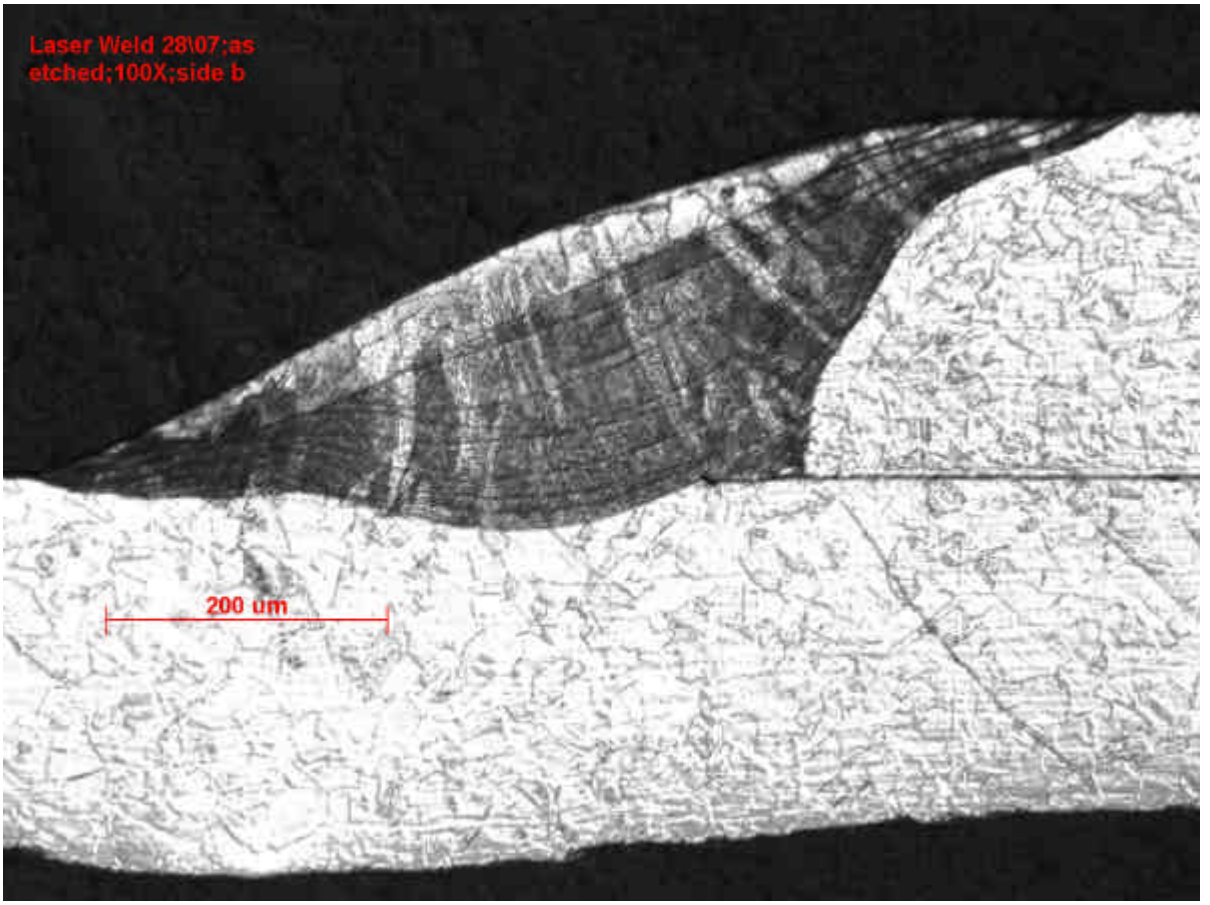
Base material : 316L

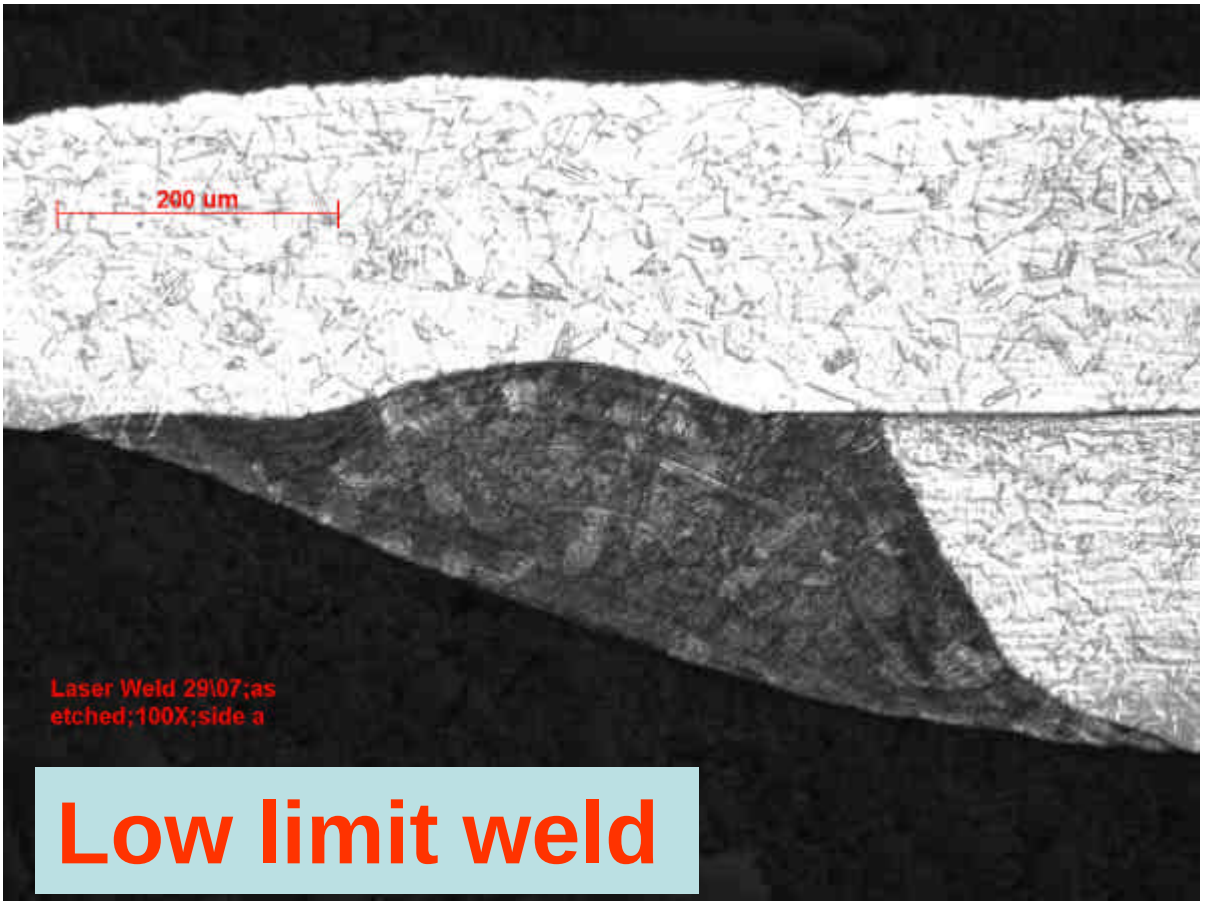
Specimen Traceability Numbers: ASM006\04\04\28\7, ASM006\04\04\28\4, ASM006\04\04\28\1

Three cross-sections were taken transverse to the laser weld, mounted, ground and polished. Then, the six weld locations on the cross-sections were electrolytically etched with 10% oxalic acid and examined on the metallograph.

The laser welds were judged to be sound and of high quality. No metallurgical anomalies were detected at magnifications up to and including 1000X. There was no notches, no lapped material, no pores, no voids, and no cracks detected. Penetration and fusion were proper for this type of socket weld.

John Figert
Metallurgical Engineer, P.E.
Lockheed Martin Space Operations





Low limit weld

Low limit Welding Procedure Specification

SHELL CHEMICALS, SRTCA

LASER WELDING PROCEDURE SPECIFICATION (WPS)

WPS Number ASM006\Qu\ou\nS\ 7 Revisio _____ Company / Organization TIC/AEI4

Welding Process(es) LASER WELDING

BASE and FILLER METAL :

Material number 45376623600 Group _____ to Material number 45376632763 3X 0.2 MM

Material spec., type, and grade 14404 DIN17458 D4/T3 to Material spec., type, & grade 14404 DIN17458 D4/T3

Base metal thickness range _____

Pipe / Tube diameter 4,00 Wall thickness 0.7

Filler metal F No. X AWS Class & Spec. _____

Consumable Insert, AWS Class & Spec _____

GAS :

Torch/Head gas(es) ARGON 4.6

% Composition 4.6 Flow Rate 6 LPM

Prepurge Time 40 SEC Postpurge Time 15 SEC

Backing gas(es) ARGON 4.6

% Composition 4.6 Flow rate _____

Prepurge Time 40 SEC Postpurge Time 15 SEC

WELDING SET-UP :

Power Supply (Model) HAAS LASER NEODYUM YAG P54

Weld Head(s) _____

Joint Position(s) _____

Tungsten type _____ Diameter _____ Arc gap _____

Tip diameter _____ Tip angle _____

Weld direction ROTATION VERT Pulse Mode _____

PRE and POSTWELD HEAT

Preheat temperature minimum _____

Preheat temperatue maximum _____

Interpass temperature minimum _____

Interpass temperature maximum _____

Postweld HeatTreatment _____

WELD SETTINGS :

KW POWER 1,4

DURATION (MS) 2,8

PULSE ENERGY 3,9 J

PULSE REPETITION FREQUENTCY 1,6 DOWNSLOPE 10 SEC

FIXTURE SPEED 0,5 RPM

F 4,75.

JOINT DESIGN

Joint type _____

Groove angle _____ Radius _____ Land _____

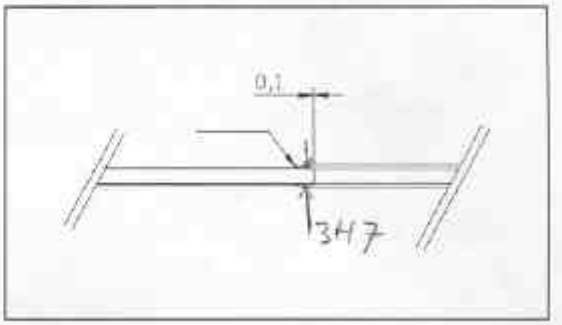
Root opening _____ Size of fillet _____

Socket weld pull-back _____

NOMINAL HEAT INPUT CONDITIONS :

Level Number	Weld Time (sec.)	Allowable Current (amps) HIGH +5%	Nominal	-5%	Settings LOW Nominal	Pulse Rate (pps)	Pulse Width Nominal
1							
2							
3							
4							

SETUP SKETCH -



TECHNIQUE :

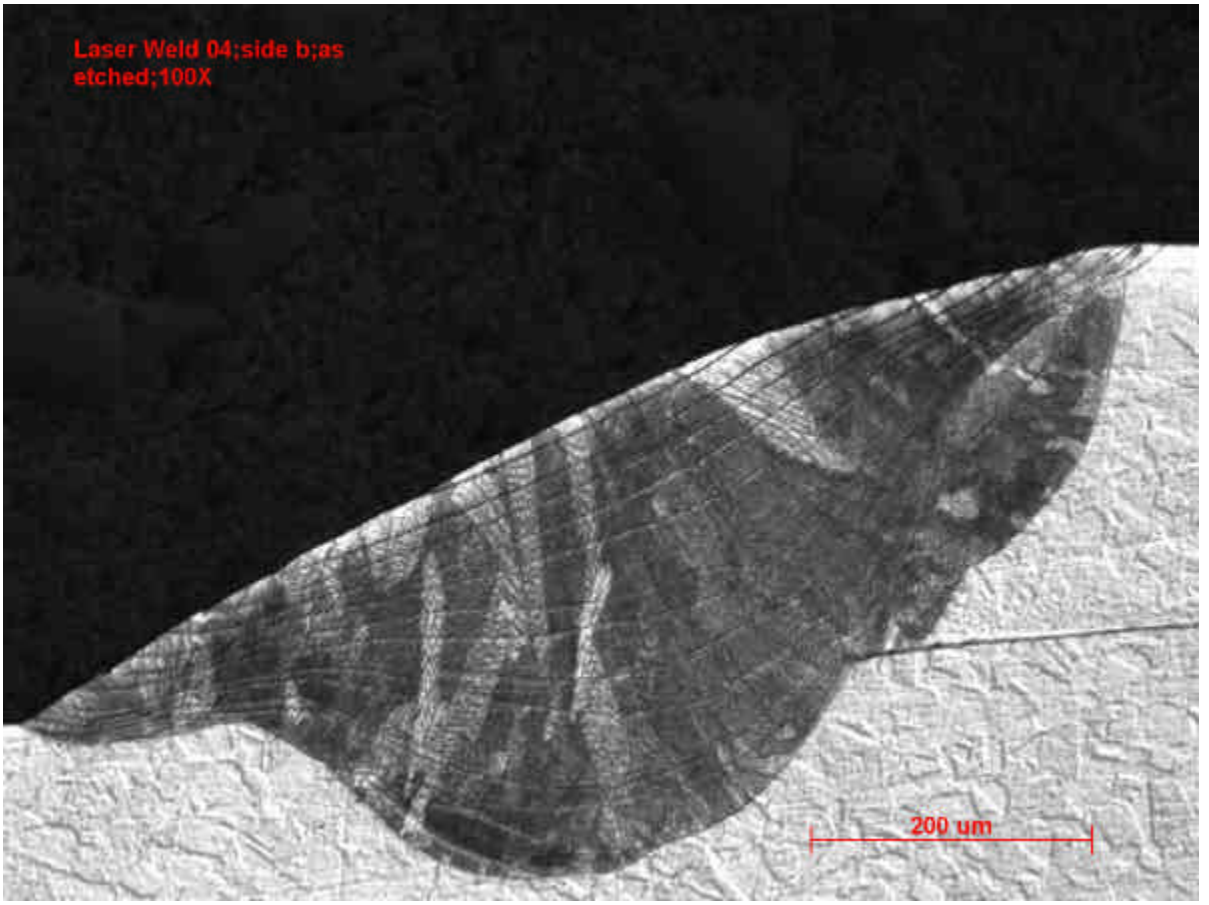
Joint cleaning etanol

Other _____

We certify that this welding procedure and schedule were qualified in accordance with the requirements of NASA / JSC PRC-0010

Prepared By H.W. GUSSEKLOO Org. _____ Date _____

Approved _____ Org. _____ Date _____


Laser Weld 04;side b;as etched;100X
200 um


200 um
Laser Weld 28\04;100X;as etched
Nominal weld

Nominal Welding Procedure Specification

SHELL CHEMICALS, SRTCA

LASER WELDING PROCEDURE SPECIFICATION (WPS)

WPS Number ASM0060404284 Revisio _____ Company / Organization TIC/AEI4

Welding Process(es) LASER WELDING

BASE and FILLER METAL :

Material number 45376823600 Group _____ to Material number 45376832763 3X 0.2 MM

Material spec., type, and grade 14404 DIN17458 D4/T3 to Material spec., type, & grade 14404 DIN17458 D4/T3

Base metal thickness range _____

Pipe / Tube diameter 4,00 Wall thickness 0.7

Filler metal F No. X AWS Class & Spec _____

Consumable Insert, AWS Class & Spec _____

GAS :

Torch/Head gas(es) ARGON 4.6

% Composition 4.6 Flow Rate 6,LPM

Prepurge Time 40 SEC Postpurge Time 15 SEC

Backing gas(es) ARGON 4.6

% Composition 4.6 Flow rate _____

Prepurge Time 40 SEC Postpurge Time 15 SEC

WELDING SET-UP :

Power Supply (Model) HAAS LASER NEODYUM YAG P54

Weld Head(s) _____

Joint Position(s) _____

Tungsten type _____ Diameter _____ Arc gap _____

Tip diameter _____ Tip angle _____

Weld direction ROTATION VERT Pulse Mode _____

PRE and POSTWELD HEAT

Preheat temperature minimum _____

Preheat temperatue maximum _____

Interpass temperature minimum _____

Interpass temperature maximum _____

Postweld HeatTreatment _____

WELD SETTINGS :

KW POWER 1,6

DURATION (MS) 2,8

PULSE ENERGY 4,48

PULSE REPETITION FREQUENTCY 1,6 DOWNSLOPE 10 SEC

FIXTURE SPEED 0,5 RPM

F 4,75

JOINT DESIGN

Joint type _____

Groove angle _____ Radius _____ Land _____

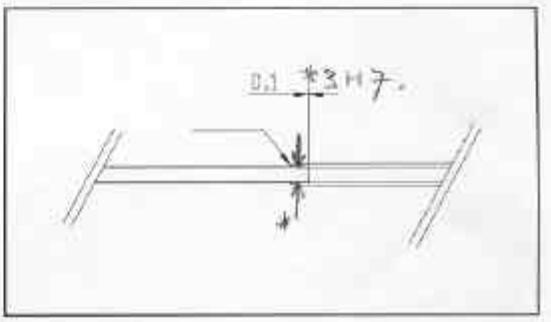
Root opening _____ Size of fillet _____

Socket weld pull-back _____

NOMINAL HEAT INPUT CONDITIONS :

Level Number	Weld Time (sec.)	Allowable Current (amps) Settings HIGH +5%	Nominal	-5%	LOW Nominal	Pulse Rate (pps)	Pulse Width Nominal
1							
2							
3							
4							

SETUP SKETCH -



TECHNIQUE :

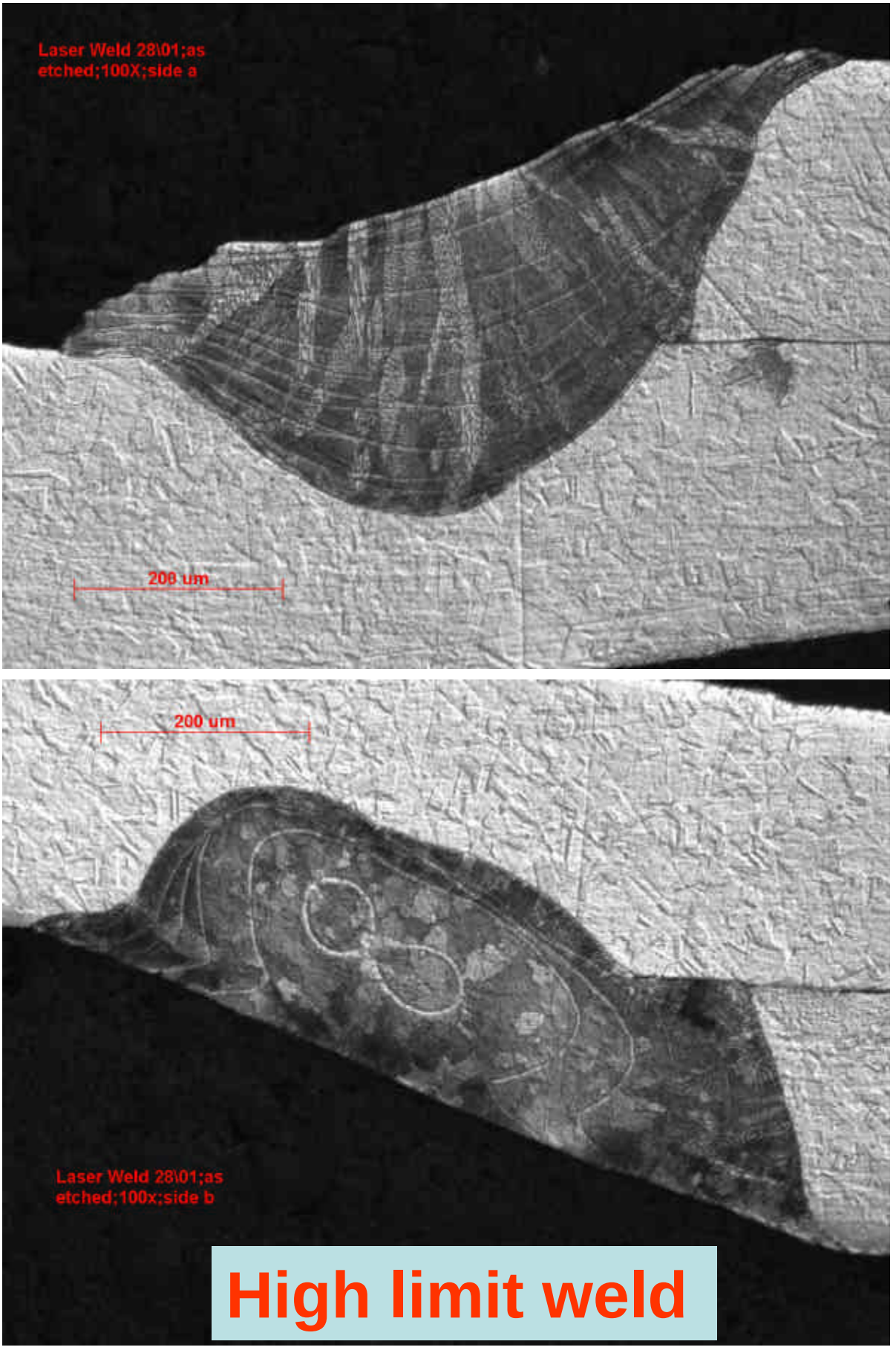
Joint cleaning etanol

Other _____

We certify that this welding procedure and schedule were qualified in accordance with the requirements of NASA / JSC PRC-0010.

Prepared By M.W. GUSSEKLOO Org _____ Date _____

Approved _____ Org _____ Date _____


Laser Weld 28\01;as
etched;100X;side a
200 um
200 um
Laser Weld 28\01;as
etched;100x;side b
High limit weld

High limit Welding Procedure Specification

SHELL CHEMICALS, SRTCA

LASER WELDING PROCEDURE SPECIFICATION (WPS)

WPS Number ASM006\0 4\04\28 Revisio _____ Company / Organization TIC/AEI4

Welding Process(es) LASER WELDING

BASE and FILLER METAL :

Material number 45378823600 Group _____ to Material number 45378832763 3X 0.2 MM

Material spec., type, and grade 14404 DIN17458 D4/T3 to Material spec., type, & grade 14404 DIN17458 D4/T3

Base metal thickness range _____

Pipe / Tube diameter 4.00 Wall thickness 0.7

Filler metal F No. X AWS Class & Spec.

Consumable Insert, AWS Class & Spec

GAS :

Torch/Head gas(es) ARGON 4.6

% Composition 4.6 Flow Rate 6 LPM

Prepurge Time 40 SEC Postpurge Time 15 SEC

Backing gas(es) ARGON 4.6

% Composition 4.6 Flow rate

Prepurge Time 40 SEC Postpurge Time 15 SEC

WELDING SET-UP :

Power Supply (Model) HAAS LASER NEODYUM YAG P54

Weld Head(s)

Joint Position(s)

Tungsten type Diameter Arc gap

Tip diameter Tip angle

Weld direction ROTATION VERT Pulse Mode

PRE and POSTWELD HEAT

Preheat temperature minimum

Preheat temperatue maximum

Interpass temperature minimum

Interpass temperature maximum

Postweld HeatTreatment

WELD SETTINGS :

KW POWER 1,8

DURATION (MS) 2,8

PULSE ENERGY 5,4

PULSE REPETITION FREQUENTCY 1,6 DOWNSLOPE 10 SEC

FIXTURE SPEED 0,5 RPM

JOINT DESIGN

Joint type

Groove angle Radius Land

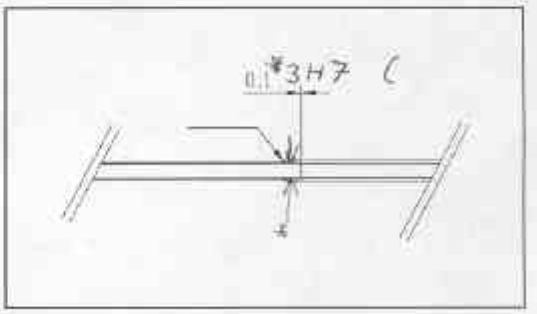
Root opening Size of fillet

Socket weld pull-back

NOMINAL HEAT INPUT CONDITIONS :

Level Number	Weld Time (sec.)	Allowable Current (amps) Settings HIGH +5%	HIGH Nominal	HIGH -5%	LOW Nominal	Pulse Rate (pps)	Pulse Width Nominal
1							
2							
3							
4							

SETUP SKETCH -



TECHNIQUE :

Joint cleaning etanol

Other

We certify that this welding procedure and schedule were qualified in accordance with the requirements of NASA / JSC PRC-0010.

Prepared By _____ Org. _____ Date _____

Approved _____ Org. _____ Date _____